

ADDITIONAL NOTES ON THE GENUS *AVICENNIA*. XIII

Harold N. Moldenke

For a detailed explanation of the herbarium acronyms used hereinafter in this paper and in all previous installments in of these notes, see my "Fifth Summary of the *Verbenaceae*...." (1971), volume 2, pages 795 to 801.

AVICENNIA L.

Additional & emended synonymy: *Avicenia* Roxb., Hort. Beng. 46. 1814. *Racka* J. F. Gmel. ex Meisn., Pl. Vasc. Gen. 2: 200, in syn. 1840. *Rack* Bruce ex Meisn., Pl. Vasc. Gen. 2: 200, in syn. 1840. *Aviccnnia* Mukherjee & Chanda, Trans. Bose Res. Inst. 41: 51, sphalm. 1978. *Avecinia* Lantoh, in herb.

Additional & emended bibliography: L., Syst. Nat., ed. 1, 18. 1740; Gled., Berl. 5: 128. 1749; B. Juss., Hort. Trian. 1759; L., Gen. Pl., ed. 6, Ord. Nat. 1764; L., Syst. Nat., ed. 12 rev. [13], 1: 426. 1767; J. A. Murr. in L., Syst. Veg., ed. 13, 484. 1774; Scop., Introd. 174. 1777; J. A. Murr. in L., Syst. Veg., ed. 14, 579. 1784; Gis., Carl. Linn. Prael. Ord. Nat. 486. 1792; Pers., Syst. Pl. 616. 1797; Duchesne, Dict. 3: 334. 1804; St.-Hil., Expos. 1: 248. 1805; P. Beauv., Fl. Oware Benin 1: 79--80 & 99, pl. 47. 1806; R. Br., Flind. Voy. 2 App. 3: 566. 1814; Roxb., Hort. Beng. 46. 1814; Spreng., Anleit. 2: 419. 1817; Steud., Nom. Bot. Phan., ed. 1, 96. 1821; Jack, Descr. Malay. Pl., imp. 1, 58--59. 1822; Jack, Malay. Misc., imp. 1, 2: 58--59. 1822; Reichenb., Ap. Mössl. 1: xxxix. 1827; Bartl., Ord. 180. 1830; Spreng. in L., Gen. Pl., ed. 9, 2: 483. 1831; Cham., Linnaea 7: 370--371. 1832; Hook. & Arn., Bot. Beech. Voy., imp. 1, 94. 1832; Piddington, Tab. View Gen. Char. Roxb. 106--107. 1836; Hook. & Arn., Bot. Beech. Voy., imp. 1, 306. 1838; Meisn., Pl. Vasc. Gen. 2: 200 & 272. 1840; Hook. & Arn., Bot. Beech. Voy., imp. 1, 449. 1841; Reichenb., Nom. 108. 1841; Spach in Orbigny, Dict. Hist. Nat. 2: 373. 1842; Jack, Calc. Journ. Nat. Hist. 4: 194--195. 1843; Nutt., N. Am. Silva 2: 144, pl. 105. 1846; Lindl., Veg. Kingd. 665. 1847; Wight, Icon. Pl. Ind. Orient. 4 (3): 12 & 16, pl. 1481 & 1482. 1849; W. Griff., Icon. Pl. Asiat. pl. 448. 1854; W. Griff., Notul. Pl. Asiat. 4: 173, 181, & 185--195. 1854; Miq., Fl. Ind. Bat. 2: 911 (1857) and Suppl. 1: 244. 1860; Turcz., Bull. Soc. Imp. Nat. Mosc. 36 (3): 226. 1863; Kurz, Rep. Veg. Andam. App. A.45. 1870; Pfeiffer, Nom. Bot. 1 (1): 339--340 & 438 (1873), 1 (2): 1847 & 1850 (1874), and 2 (2): 1569, 1570, & 1593. 1874; F. Muell., Descr. Notes Pap. Pl., imp. 1, 91 & 110. 1875; Kurz, Forest Fl. Brit. Burma 2: 252, 275--276, & 587. 1877; Fern.-Villar in Blanco, Fl. Filip., ed. 3, 4: Nov. App. 162. 1880; Vidal, Sin. Gen. Fam. Pl. Leñ. Filip. [Introd. Fl. For. Filip.] 1: 201, 206, & 336 (1883) and 2 [Atlas]: 36, pl. 75, fig. G. 1883; Balf. f., Trans. Roy. Soc. Edinb. 31: [Bot. Socotra] 237 & 414. 1888; Warb., Engl. Bot. Jahrb. 13: 426--427. 1891; Brehm, Merv. Nat. Monde Pl. 2: 348. 1894; Gürke in

Engl., Pflanzenw. Ost-Afr. C: 342. 1895; Briq. in Engl. & Prantl, Nat. Pflanzenfam., ed. 1, 4 (3a): [381]. 1897; Engl., Syllab. Pflanzenfam., ed. 2, 178 & 198. 1898; Koord. & Valet., Meded. Lands Plant. Bat. 42 [Bijd. Booms. Java 7]: 164 & 215--222. 1900; Gamble, Man. Indian Timb., ed. 2, imp. 1, 511, 524, & 546. 1902; Engl., Syllab. Pflanzenfam., ed. 3, 188 & 216. 1903; J. C. Willis, Dict. Flow. Pl., ed. 2, 256 & 605. 1903; Dalla Torre & Harms, Gen. Siphonog., imp. 1, 434. 1904; Engl., Syllab. Pflanzenfam., ed. 4, 189 & 220. 1904; F. N. Williams, Bull. Herb. Boiss., ser. 2, 5: 432. 1905; Pobéguin, Pl. Méd. Guin. 341. 1906; Engl., Syllab. Pflanzenfam., ed. 5, 193 & 225. 1907; N. L. Britton, N. Am. Trees 826, fig. 754 & 755. 1908; King & Gamble, Journ. Asiat. Soc. Beng. 74 (2 extra): 795 & 867--869. 1908; J. C. Willis, Dict. Flow. Pl., ed. 3, 2-5 & 622. 1908; Engl., Syllab. Pflanzenfam., ed. 6, 198 & 231. 1909; Bot. Cong. Brux. 2: pl. 12--14. 1910; Howe, Journ. N. Y. Bot. Gard. 12: 63. 1911; Engl., Syllab. Pflanzenfam., ed. 7, 314--315 & 361. 1912; Justs Bot. Jahresber. 39 (1): 999. 1913; Tobler, Engl. Bot. Jahrb. 50: Suppl. 398--404. 1914; Wangerin, Justs Bot. Jahresber. 40 (1): 862. 1914; Fedde, Justs Bot. Jahresber. 39 (2): 1314. 1916; B. L. Robinson, Proc. Am. Acad. Sci. 5: 531. 1916; H. Hallier, Meded. Rijks Herb. Leid. 37: 87--91. 1918; Gilg in Engl., Syllab. Pflanzenfam., ed. 8, 319 & 367. 1919; Pellett, Am. Honey Pl., ed. 1, 38 & 39, fig. 22 & 23. 1920; Wangerin, Justs Bot. Jahresber. 42: 363 & 364. 1920; Gamble, Man. Indian Timb., ed. 2, imp. 2, 511, 524, & 546. 1922; Haines, Bot. Bihar Orissa, ed. 1, 4: 704 & 724--725. 1922; Wangerin, Justs Bot. Jahresber. 42: 413. 1922; Fedde, Justs Bot. Jahresber. 42: 822. 1923; Gilg in Engl., Syllab. Pflanzenfam., ed. 9 & 10, 340 & 391. 1924; Haines, Bot. Bihar Orissa, ed. 1, 1: 143. 1925; J. C. Willis, Dict. Flow. Pl., ed. 5, 65 & 678. 1925; Knuth, Feddes Repert. Spec. Nov. Beih. 43: [Init. Fl. Venez.] 608. 1927; Chiov., Fl. Somala [1]: 65 & 274--275. 1929; E. D. Merr., Univ. Calif. Publ. Bot. 15: 268. 1929; Exell, Journ. Bot. Lond. 69, Suppl. 2: 146. 1931; Stapf, Ind. Lond. 6: 536. 1931; Troll & Dragendorff, Planta [Arch. Wiss. Bot.] 13: 311 & 330. 1931; Clason-Laarman, Trop. Natuur 21: 26. 1932; Dop in Lecomte, Fl. Gén. Indo-chine 4: 776 & 892--896, fig. 92 (5--8). 1935; Kirtikar & Basu, Indian Med. Pl., ed. 2, imp. 1, 3: 1912 & 1952--1955, pl. 748. 1935; Bedevian, Illustr. Polyglott. Dict. 99. 1936; Diels in Engl., Syllab. Pflanzenfam., ed. 11, 339 & 389. 1936; Dop in Lecomte, Fl. Gén. Indo-chine 4: 897, fig. 93 (1). 1936; Fletcher, Kew Bull. Misc. Inf. 1938: 401, 405--407, 409, & 443--444. 1938; Worsdell, Ind. Lond. Suppl. 1: 111. 1941; Savage, Cat. Linn. Herb. Lond. 110, 117, & [221]. 1945; V. Chapm., Proc. Linn. Soc. Lond. 158: 2--6. 1947; Perez-Arbelaez, Pl. Util. Colomb., ed. 1, 442. 1947; H. N. & A. L. Mold., Pl. Life 2: 16, 18, 20--24, 26--29, 36, 37, 42, 43, 51, 56, 68, 72, 80, 81, 83, 86, 92, & 93. 1948; Metcalfe & Chalk, Anat. Dicot. 2: [1028], 1030--1033, & 1035--1041, fig. 248 A & G. 1950; Lawrence, Taxon. Vasc. Pl., imp. 1, 687 & 780. 1951; J. C. Willis, Dict. Flow. Pl., ed. 6, 65 & 678. 1951; Perez-Arbelaez, Pl. Util. Colomb., ed. 2, 740. 1956; Alain in León & Alain, Fl. Cuba, imp. 1, 4: 279, 280, 323, 525, & 528, fig. 139. 1957; Angely, Bot. Ap-

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The genus number for *Avicennia* in the Linnean Herbarium is 813 as correctly stated by Savage (1945). Duncan (1974), Napp-Zinn (1974), Walsh (1974), and Thanikaimoni (1976), as well as Terrell, have joined the ever-increasing ranks of botanists who accept the *Avicenniaceae* as a valid and distinct family of plants. Novak (1961) agrees with Junell (1934) in placing the genus in the *Lamiaceae*. Some authors give *Guapira* Aubl. and *Mangium album* Rumpf as synonyms of *Avicennia*, but the former is a synonym of *Pisonia* L. in the *Pisoniaceae* and the latter belongs in the synonymy of *Avicennia marina* var. *rumphiana* (H. Hallier) Bakh.

According to Chapman (1976) the known uses of members of *Avicennia* include the wood employed as an inferior firewood; resin and ointment made from the seeds is applied to ulcers and tumors; the bark is used in the treatment of skin parasites and gangrenous wounds; the wood is used for making charcoal; the foliage is used as food for camels; salt is extracted from the wood ash; the seedlings are eaten; and the nectar is used by honeybees in the manufacture of their honey. He lists the following algae that are often found in connection with *Avicennia*: *Catenella impudica*, *Dictyota* sp., and *Dictyopteris propagulifera*. He also lists the following terrestrial fungi as attacking the genus: *Botrytis argillacea* var. *avicenniae* McAlp., *Eudimerium avicenniae* Hansf., *Fomes avicenniae* Bacc., *Irene sepulta* (Pat.) Toro, *Schizophyllum commune* (Fries) Fries, and *Sphaeronaema avicenniae* Frag. & Cif.

Zamski (1979) discusses the mode of secondary growth and the 3-dimensional structure of the phloem in *Avicennia*. He reports that "The mode of development of successive cambia and the differentiation of cambium derivatives are unique to *Avicennia*...and do not follow the scheme proposed for members of other families possessing included phloem. The sequence of formation of cambial derivatives and their differentiation are: there are few parenchyma cells toward the inside; the xylem is toward the inside with continued production of up to 10 files of parenchyma cells toward the outside; a ring of 1--3 sclereids thick develops, 1--3 cells from the outer limit of the secondary parenchyma files; the scler-

eids start to develop very early, sometimes when only 4 outer cambial derivatives have been produced; the cambium gradually ceases to function and phloem strands are formed by cell divisions in the parenchyma files, only short fragmented cambium remnants are left on the inner side of the phloem; and a new cambium develops in the most distal parenchyma file, immediately outside the sclereids. The new cambium layer originates withing the outer parenchyma cells which were among the first derivatives of the previous cambium. Occasionally the sclereids do not form a complete ring and the cambium produces a conjunctive-tissue connection through the gap. The phloem strands associate in a very complicated net-like structure. There are many tangential links within the same ring and radial links through a conjunctive-tissue connection between adjacent rings."

AVICENNIA AFRICANA P. Beauv.

Additional bibliography: D. Dietr., Syn. Pl. 3: 619. 1843; Pobéguin, Pl. Méd. Guin. 341. 1906; Stapf, Ind. Lond. 1: 370. 1929; Exell, Journ. Bot. 69, Suppl. 2: 146. 1931; Walsh in Reimold & Queen, Ecol. Haloph. 59. 1974; V. J. Chapm., Mangr. Veg. 19, 21, 24, 27, 75, 76, 78, 80, 81, 85, 86, 221, 222, 265, 281, 372, 374, 378, 390, & 436, fig. 4, 11, 55, 57, & 176 b & c. 1976; Mold., Biol. Abstr. 61: 4888. 1976; Terrell, U. S. Dept. Agr. Agric. Handb. 505: 17 & 160. 1977; Mold., Phytologia 40: 407 & 409. 1978; Hocking, Excerpt. Bot. A.33: 89. 1979; J. & E. Kohlmeyer, Marine Mycol. 93, 95, 96, 319, 389, 400, 414, & 535. 1979; Mold., Phytologia 46: 60. 1980.

Additional illustrations: V. J. Chapm., Mangr. Veg. fig. 4, 57, & 176 b & c. 1976.

Chapman (1976) lists the following marine fungi often found on *A. africana*: *Didymosphaeria enalia* Kohlm., *Leptosphaeria avicenniae* J. & E. Kohlm., *Lulworthia* sp., and *Phoma* sp.

Pobéguin (1906) cites *Conakry 1228* from the Republic of Guinea. Additional citations: LIBERIA: Mayer 164 (W--2630439).

AVICENNIA ALBA Blume

Additional & emended bibliography: W. Griff., Notul. Pl. Asiat. 4: 185--188 & 190--195. 1854; Miq., Fl. Ind. Bat. Suppl. 1: 244. 1860; Koord & Valet., Meded. Lands Plant. Bat. 42 [Bijdr. Booms. Java 7]: 216 & 221--222. 1900; King & Gamble, Journ. Asiat. Soc. Beng. 74 (2 extra): 867--869. 1908; E. D. Merr., Interpret. Rumph. Herb. Amb. 456. 1917; Haines, Bot. Bihar Orissa, ed. 1, 725. 1922; E. D. Merr., Univ. Calif. Publ. Bot. 15: 268. 1929; Stapf, Ind. Lond. 1: 370. 1929; Dop in Lecomte, Fl. Gén. Indo-chine 4: 894--895. 1935; Fletcher, Kew Bull. Misc. Inf. 1938: 405 & 443--444. 1938; Worsdell, Ind. Lond. Suppl. 1: 111. 1941; Haines, Bot. Bihar Orissa, ed. 2, 2: 760. 1961; Jafri, Fl. Karachi 290 & 351. 1966; Walsh in Reimold & Queen, Ecol. Haloph. 59, 84--86, 95, 97, 98, 106, & 152. 1974; V. J. Chapm., Mangr. Veg. 3, 20, 26, 27, 105--109, 113, 114, 118, 123, 125, 128, 129, 132, 134, 136, 139, 141, 144, 148, 250, 252, 268, 271, 288, 289, 308, 310, 390, 405, 416,

& 436, fig. 11, 74, 77a--79, 83, 186b, & 213 (4). 1976; Hepper in Edlin & Nimmo, *Illust. Encycl. Trees* 226--228. 1978; Mold., *Phytologia* 40: 407--409 & 412. 1978.

Additional illustrations: V. J. Chapm., *Mangr. Veg.* fig. 77a, 186b, & 213 (4). 1976; Hepper in Edlin & Nimmo, *Illust. Encycl. Trees* 226 (in color). 1978.

Recent collectors describe this species as a tree, 3--10 m. tall, the bole 15 cm. in diameter, the crown 4 m. wide, and the corollas 4-parted, and have found it in flower in December, January, and April. The corollas are said to have been "pale orange yellow" on *Meijer SAN.24927*, "light-orange" on *Canfield 374*, "orange-yellowish" on *Meijer SAN.56058*, and "yellow" on *Canfield 321*. *Canfield* refers to it as a "common tree in mud at edge of mangrove with *Bruguiera*, *Scyphiphora*, *Xylocarpus*, *Nypa*, *Schefflera*, and *Derris*;" and as a "common tree in clearings along river in volcanic clay soil with *Nypa*, *Derris*, and *Rhizophora*", at 2--5 m. altitude. Santapau & Shah (1969) list the species from Salsette island. Dietrich (1843) gives the distribution of the species as "Java et Arabia felix" -- it does not, of course, occur in Arabia, where *A. marina* (Forsk.) Vierh. is the only native species of the genus.

Walsh (1974) records the chromosome number as 16. Fletcher (1938) notes that the nomenclatural type of the species is from the Malay Archipelago and lists the plant from India, Cochinchina [Vietnam], to northern Australia. From Thailand he cites *Kerr 4027*, *8920*, *9163*, *10969*, *14236*, *16581*, *17948*, & *19070* and *Put 1721*.

The *Nicholson 19126*, distributed as *A. alba*, actually is *A. marina* (Forsk.) Vierh., as is also *Meijer SAN.27653*, while *Lantoh SAN.62376* is *A. officinalis* L.

Additional citations: PALAU ISLANDS: Babeldaob: *Canfield 321* (W--2839227), *374* (W--2839230). Yap: *Falanruw 3365* (W--2881150). GREATER SUNDA ISLANDS: Sabah: *Meijer SAN.24927* (Ld), *SAN.56058* (Ld).

AVICENNIA BALANOPHORA Stapf & Mold.

Additional bibliography: Walsh in Reimold & Queen, *Ecol. Haloph.* 59. 1974; V. J. Chapm., *Mangr. Veg.* 3, 20, 24, 390, 391, & fig. 11. 1976; Mold., *Phytologia* 33: 240. 1976.

Walsh (1974) misspells Stapf's surname as "Stapft".

AVICENNIA BICOLOR Standl.

Additional bibliography: Walsh in Reimold & Queen, *Ecol. Haloph.* 59. 1974; V. J. Chapm., *Mangr. Veg.* 21, 24, 67, 68, 390, 391, & 436, fig. 11 & 48b. 1976; Mold., *Phytologia* 40: 408. 1978; Rabinowitz, *Biol. Abstr.* 66: 6272. 1978; Rabinowitz, *Biotropica* 10: 47 & 48. 1978; Rabinowitz, *Journ. Ecol.* 66: 45--52. 1978

Additional illustrations: V. J. Chapm., *Mangr. Veg.* fig. 48b. 1976.

[to be continued]